UNITED STATES PATENT AND TRADEMARK OFFICE

Re:	Application of:	Thomas STRASSER, et al.
	Serial No.:	Not yet known
	Filed:	Herewith
	For:	DEVICE AND METHOD FOR EVALUATING VOCAL PERFORMANCE

LETTER RE PRIORITY AND SUBMISSION OF PRIORITY DOCUMENT

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

June 27, 2003

Dear Sir:

Applicants hereby claim the priority of Brazilian Patent Application No. PI0202561-2 filed July 4, 2002, a certified copy of which is submitted herewith together with a verified English language translation thereof.

Respectfully submitted,

By: _____
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FEDERATIVE REPUBLIC OF BRAZIL
MINISTRY OF INDUSTRY, DEVELOPMENT AND FOREIGN TRADE
"INSTITUTO NACIONAL DA PROPRIEDADE INDUSTRIAL"
[NATIONAL INSTITUTE OF INDUSTRIAL PROPERTY]

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FOR PRIORITY CLAIM PURPOSES

The attached document is a true copy
of a Patent of Invention Application,
duly registered at the National Institute
of Industrial Property, under Number
PI 0202561-2 of July 4, 2002

Rio de Janeiro, June 16, 2003.

Signed: [illegible signature]
Name: GLORIA REGINA COSTA
Head of NUCAD
Mat. 00449119

Protocol   Number

PATENT DEPOSIT

FILING

Patent or Addition   **PI0202561-2**   deposit / /
Certificate Application Form   (deposit date)

To "Instituto Nacional da Propriedade Industrial" [National Institute of Industrial Property]:

The applicant hereby requests the grant of a patent in accordance with the nature and conditions below:

1. Applicant (71):
1.1 Name: GENIUS – INSTITUTO DE TECNOLOGIA
1.2 Qualification: BRAZ. COMP.   1.3 CGC/CPF: 03521618000195
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2. Nature:
☒ 2.1 Invention ☐ 2.1.1 Addition Certificate ☐ 2.2 Utility Model

Write down, compulsorily and in full, the Nature desired: INVENTION

3. Title of Invention, Utility Model or Addition Certificate (54):
"DEVICE AND METHOD FOR EVALUATING ..."

                                          ☒ continued in annexed page

4. Division Application for application n°   , from
5. Internal Priority – The applicant claims the following priority:
        Filing number   Filing Date   (66)
6. Priority – The applicant claims the following priority(ies):

Country or organization of origin	Deposit number	Deposit date

                                          ☐ continued in annexed page

7. Inventor (72):
☐ Mark here if the depositor(s) request non publishing of their name(s)
    (art. 6th § 4th of LPI and item 1.1 of Normative Act n° 127/97)
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⊠ continued in annexed page

8. Declaration in the form of item 3.2 of Normative Act n° 127/97:

☐ annexed

9. Declaration of non-harmful previous publication (Grace period):
(art. 12 of LPI and item 2 of Normative Act n° 127/97):

☐ annexed

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11. Annexed documents (mark and also indicate the number of pages):
(Only the total number of one of the copies of each document shall be indicated)

⊠	11.1 Collection form	01 pages	⊠	11.5 Describing report	10 pages
⊠	11.2 Procurement	01 pages	⊠	11.6 Claims	03 pages
☐	11.3 Priority documents	pages	⊠	11.7 Drawings	02 pages
☐	11.4 Labor contract doc.	pages	⊠	11.8 Summary	01 pages
⊠	11.9 Others (specify): CESSION DOC./SUPL. PAGE				06 pages
	11.10 Total of annexed pages:				24 pages

12. I declare, under the penalties of law, that all information above declared is complete and true

RIO DE JANEIRO July 3, 2002   _____
Place and Date   Signature and Stamp

Britânia Marcas e Patentes S/C Ltda. CGC 50589 423/0001-67
Luiz Esteves Ortega 026.319.708-53
REG/ INPI N° 0409

Form 1.01 – Patent Request or Addition Certificate Deposit (page 2/2)

SUPPLEMENTARY SHEET

Box 3: TITLE:

Complete Invention Title:

"DEVICE AND METHOD FOR EVALUATING VOCAL PERFORMANCE"

Box 7: INVENTORS:

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São Paulo, January 20, 2003

(back stamp)

"DEVICE AND METHOD FOR EVALUATING VOCAL PERFORMANCE"

This patent of Invention refers to a new **"DEVICE AND METHOD FOR EVALUATING VOCAL PERFORMANCE"**, destined to evaluate various aspects of a singer's performance in comparison to a reference voice; to provide the singer, during the evaluation, with visual indication of how to improve his/her performance; and to present, at the end of the evaluation, a general report on the singer's performance, which shall include a summary of his/her performance to each aspect and a final general result.

The device in question was developed modularly, in order that it allows the insertion or removal of aspects to be evaluated, and in a scaleable way, so as it may be used in systems with different computational resources available for the execution of the evaluation.

The device object hereof was developed to be used specifically, but not exclusively, in electronic systems equipped with the function of vocal substitution in songs, widely known as *karaoke*.

As known, the system of vocal substitution in songs (*karaoke*) basically operates by removing from the song the audio signal correspondent to the reference voice, which will be substituted by inserting the audio signal correspondent to the singer's voice.

Figure 1 attached hereto demonstrates a block diagram of an equipment incorporating an usual system of voice substitution (or *karaoke*) (I). As illustrated in said

block diagram, a original song is an audio signal originated from an audio source (1), which may be a DVD, CD, a memory, or any other source. The system (I) foresees the removal (2) of the voice signal from the original song,

5 which is made through algorithms or adequate filters, depending on the type (analogical or digital) and on the codification of the audio signal. Said system (I) also foresees the inclusion (3) of the singer's voice signal [originated from a microphone (4), for instance], which is

10 made through a mixing procedure (or mixture), or through simultaneous and synchronized reproduction of the accompaniment and voice of the singer.

In order to improve the capacity of entertainment of these usual systems for vocal substitution (or *karaoke*),

15 the singer generally receives a score for his/her performance at the end of the song.

Various examples of *karaoke* apparatus with function of calculation of score are broadly known. One of them consists in the object of patent US 5,557,056, wherein the

20 score is calculated by comparing the volume of the song's accompaniment signal and the volume of the singer's voice signal. Patent US 5,719,344 also foresees a method to provide a score based on the measurement of the reference voice signal and the singer's voice signal.

25 Patent US 6,326,536 foresees a method for the calculation of score based on the volume measured of the reference voice and the singer's voice, proposed to

computational systems with low processing capacity.

More recently, improvements have been proposed in order to increase the entertainment of users, such as the competition system included in patent US 6,352,432. In this patent, various singers may sing simultaneously the same song, obtaining information of superiority/inferiority of a singer in relation to the others while singing. This same information is submitted in the form of images that represent a contest between animated characters. This equipment uses information of tone, rhythm, and volume.

Patent US 5,750,912 proposes the alteration of the singer's voice according to the original song by using information of tone, so as it reproduces a performance better than the original. Patent US 5,804,752, on its turn, proposes a method for attributing individual scores to two singers singing in duet.

Various deficiencies have been observed in the solutions proposed. First of all, the devices proposing the evaluation of determined aspects of the singer's performance require high amount of computational resources, which makes the product expensive. On the other hand, the devices that may be used under limited computational resources fail due to the evaluation of the volume only, which is extremely dependent on the equipment and respective accessories, especially the microphone, and not intrinsically related to the singer's performance.

The devices of evaluation proposed also fail when

providing the result only at the end of the song. And when these devices evaluate the singer's performance in more than one aspect, they do not present the results individually, which impedes the singer from having tips of

5 how to improve his/her performance in each individual aspect.

Thus, none of the solutions proposed provides the singer with detailed information on his/her performance while singing, which would allow him/her to improve the

10 performance during the song, nor information at the end of the song of how the singer could improve his/her performance for next time.

The sole apparent exception is the system proposed in patent US 6,352,432 mentioned above. However, this

15 system indicates only if the singer's performance is better or worse than another singer competing with him/her, not indicating how the singer could improve his/her performance.

In summary, there is not an evaluating device that

20 may be used both in equipment with low level of computational resources available and in equipment with high level of computational resources and, therefore, more expensive, that provides the evaluation of each aspect of the singer independently, during and at the end of the

25 song, in order to guide the singer concerning his/her performance and allowing the easy inclusion and removal of the aspects evaluated.

Aiming to provide an evaluating device that integrates all these characteristics and that would consequently eliminate the deficiencies in the evaluating devices known, this **"DEVICE AND METHOD FOR EVALUATING VOCAL**

5 **PERFORMANCE"** is created to be used in various types of systems and environments, not limited to specific sections of the *karaoke* market, nor to this market only, but also to other equipment, including the use by professional singers. The device invented herein further provides an evaluation

10 with quality superior to the best evaluating devices currently available on the market, due to the utilization of a adequateness and calibration method of said evaluation.

The main aspects in which the sound description is

15 based generally are:

- Melody (or tone): sequence of the fundamental frequencies of each note;

- Rhythm: sequence of duration of each note;

- Timbre: spectral compound of each note;

20 - Harmony: combination of two or more notes played simultaneously.

Satisfactory results of evaluation may be obtained by using melody, rhythm, and volume of voice signals, considering that the device object hereof allow the use of

25 any sets of aspects.

The device object hereof foresees the characteristics of modularity, which allows the addition,

removal, or modification of the aspects (modules) of evaluation, and of scale, which allow the redefinition of the aspects to be evaluated and the re-dimensioning of the resources necessary for processing the singer's voice and

5 the reference voice. Then, the incorporation of the evaluating device proposed herein to various systems is possible, such as processor attached to DVD equipment (regardless of the platform used), in digital signal processors (DSP), or in other platforms, whether as

10 software or hardware. Thus, the device in question allows an adequateness of the quality of evaluation to the computational resources available.

Figure 2 attached hereto demonstrates a block diagram of an equipment that incorporates an usual system

15 of vocal substitution (which may be a *karaoke*), such as the one illustrated in Figure 1, however incorporating the evaluating device object of this invention (II).

As illustrated in said block diagram, the original song is an audio signal originated from an audio source

20 (1), which may be a DVD, CD, a memory, or any other source. The system (I) foresees the removal (2) of the reference signal, and the inclusion (3) of the singer's voice signal [from a microphone, for instance (4)].

As illustrated in the same block diagram, the

25 evaluating device invented herein (II) receives, as input, the signal of the reference voice removed from the original song originated in the source (1), *from which the*

accompaniment (5) is removed, as well as the singer's voice signal obtained, for instance, from the audio signal generated by the microphone (4). The evaluation is carried out by processing (6) the signals received as entry. The adequateness of said processing to the computational resources available and the calibration of the results of the evaluation are carried out whenever the device is modified or transported to new platforms by an adequateness and calibration method (7), which uses information of calibration originated from the results of the evaluation of a heterogeneous group of human evaluators, and from the results of the evaluation of the device for the same set of singing executions. The result of the evaluation is submitted to the user interface device (8), which generates visual and auditory feedback during the execution of the song, providing information on the various evaluated aspects, and, at the end of the song, a visual and auditory evaluation representing the general performance of the singer evaluated and the performance in relation to each one of the aspects evaluated.

The device of visual feedback uses icons, sentences, and sounds to provide the singer with instantaneous and individual evaluation of each aspect during the song, in order to indicate the singer how he/she may improve the performance.

In order to guarantee the quality of the result of the evaluation, a data base of evaluation was prepared

through the realization of field tests with a significant number of volunteer evaluators. The tests consisted in recording the singer performance of a heterogeneous group of singers and in registering, by each volunteer evaluator,

5 the evaluation of performance of the respective singer. After all evaluations are complete, they were tabulated and used as a calibration standards of the global evaluation of the singer supplied by the device.

Concerning the modular and scalar characteristic of

10 the device invented herein, and in order to allow its easy adaptation and portability, the evaluating device in question presents the following characteristics:

- The device foresees the standardization of the interface in the implementation of the evaluation of each

15 aspect, allowing the addition, removal, and/or modification of a determined aspect. Additionally, the processing of inputs may be defined based on the relation between the quality of its results and the quantity of computational resources consumed thereby.

20 - The device further foresees the standardization of the interface in the implementation of the acquisition of samples. This allows any combination of reference channels and evaluated channels to be implemented with minimum effort.

25 - The device foresees the parameterization of the acquisition of samples. Thus, to each reference channel or to each evaluated channel, the alteration in the sampling

rate and other parameters related to the acquisition may be carried out with minimum effort. This is important to the portability, since the parameters of acquisition depend on the apparatus wherein the device is built in.

5　　　　- Finally, the device foresees the simplification of its interface as a whole, through the standardization of the entry and exit devices. Thus, the task of building the device in a determined apparatus involves few alterations in the original system.

10　　　　Once the processing is defined in order to adequate the device to the quantity of computational resources available, the calibration of the device for the maximization of the evaluating quality is made through the optimization of the similarity of the results collected

15　from the evaluation of performance of an heterogeneous group of singers by an heterogeneous group of human evaluators, and from the results collected from the evaluation of the same executions in the same group of singers by the evaluating device invented herein (with the

20　limitations of resources applicable). The more computational resources are available, the better will be the evaluations. The scalar characteristic allows that these resources may be used on an improved manner, supplying an evaluation of quality superior to those known,

25　due to the set of resources available.

　　　　The advantages of the implementation of the device invented herein are: possibility of solution of additional

hardware components with zero cost, in case of implementation of the device in software; large flexibility, allowing the development of an evaluating device with more quality than those currently existent in commercial apparatuses, even with limited computational resources; and the possibility of implementation in different platforms.

CLAIMS

1) **"DEVICE AND METHOD FOR EVALUATING VOCAL PERFORMANCE"**, based on an entry device that provides a sequence of blocks of samples from the singer's voice signal to be evaluated,

5 and a sequence of blocks of samples from a reference voice signal, and on the measurement of the similarity between the signals supplied by the entry device, through the processing of multiple aspects, **characterized** by: device for the delivery of information to be used for the

10 generation of visual and auditory feedback for didactic purposes in relation to the partial results of said comparisons, and visual and auditory feedback for didactic purposes in relation to the final result of said evaluation of similarity, as well as a summary of the evaluation of

15 similarity of each one of said aspects; method of adaptation that allows the addition, removal, or modification of the aspects of said set of aspects, which therefore makes the device modular, allowing the adjustment of the level of quality of said evaluations of similarity

20 carried out based on the processing of the singer's voice and the reference voice, so as to adequate said evaluations of similarity to the computational resources available, therefore providing the device with scalar characteristics.

2) **"DEVICE AND METHOD FOR EVALUATING VOCAL PERFORMANCE"**, as

25 of claim 1, **characterized** by: device likely to be embedded into various systems, such as systems of vocal substitution in songs (*karaoke*), processors of DVD, CD apparatus, etc.,

digital signal processors (DSP), or any other platforms, whether as software or hardware.

3) **"DEVICE AND METHOD FOR EVALUATING VOCAL PERFORMANCE"**, as of claim 1, <u>**characterized**</u> by: feedback device that uses icons, phrases and sounds to provide the singer evaluated during the execution of the song, visually and acoustically, with instantaneous and individual evaluations of each aspect evaluated based on the results of the processing of the voice of the singer evaluated and the reference voice, in periods determined experimentally, and, at the end, a summary reporting the performance of the singer evaluated in each aspect, so as it may indicate how the singer evaluated may improve his/her performance during the execution of the song and on the next time.

4) **"DEVICE AND METHOD FOR EVALUATING VOCAL PERFORMANCE"**, as of claim 1, <u>**characterized**</u> by: device that allows the alteration, by adding, removing or modifying aspects to be used in the evaluation, and modification of the processing of the voice of the evaluated singer and the reference voice, making the device modular and scalar.

5) **"DEVICE AND METHOD FOR EVALUATING VOCAL PERFORMANCE"**, as of claims 1 and 4, <u>**characterized**</u> by: method of adequateness and calibration of the device for evaluating vocal performance to the set of computational resources available, aiming to maximize the quality of the evaluation, by optimizing the similarity between the results collected from the evaluation of performance of a

heterogeneous group of singers by a heterogeneous group of human evaluators, and the results collected from the evaluation of the same executions of the same group of singers by said evaluating device submitted to the

5 limitations of computational resources applicable and to said pertinent alterations.

6) **"DEVICE AND METHOD FOR EVALUATING VOCAL PERFORMANCE"**, as of claims 1, 4, and 5, **characterized** by: feedback device that uses icons, phrases, and sounds to provide the singer

10 visually and auditorily with a global evaluation of his/her performance at the end of the song, based on the results of the processing of the voice of the singer evaluated and the reference voice, and calibrated by said method of adequateness and calibration, in order to simulate the

15 evaluation of a heterogeneous group of human evaluators.

SUMMARY

"DEVICE AND METHOD FOR EVALUATING VOCAL PERFORMANCE", based on an entry device that provides a sequence of blocks of samples from the singer's voice signal to be evaluated, and a sequence of blocks of samples from a reference voice signal, and on the measurement of the similarity between the signals supplied by the entry device, through the processing of multiple aspects, and which foresees a device for the delivery of information to be used for the generation of visual and auditory feedback for didactic purposes in relation to the partial results of said comparisons, and visual and auditory feedback for didactic purposes in relation to the final result of said evaluation of similarity, as well as a summary of the evaluation of similarity of each one of said aspects; and a method of adaptation that allows the addition, removal, or modification of the aspects of said set of aspects, which therefore makes the device modular, allowing the adjustment of the level of quality of said evaluations of similarity carried out based on the processing of the singer's voice and the reference voice, so as to adequate said evaluations of similarity to the computational resources available, therefore providing the device with scalar characteristics.
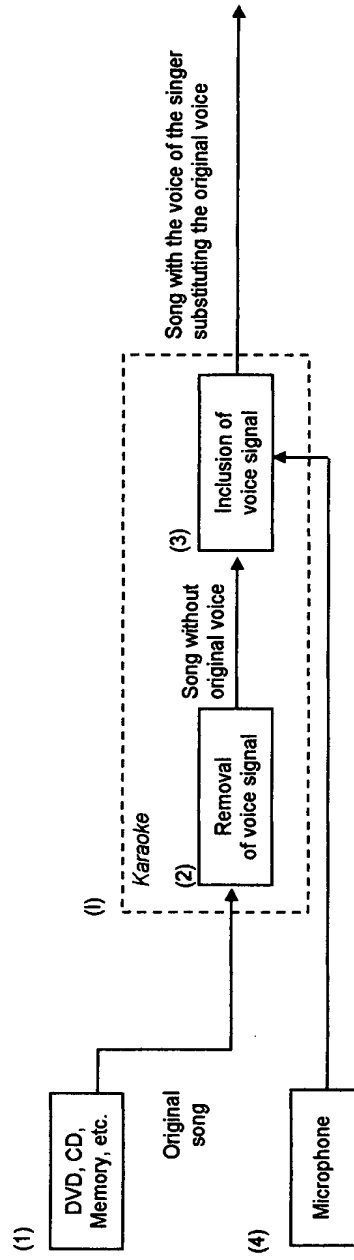
FIGURE 1

Song with the voice of the singer substituting the original voice

Karaoke

(3) Inclusion of voice signal

Song without original voice

(2) Removal of voice signal

(I)

(1) DVD, CD, Memory, etc.

Original song

(4) Microphone

FIGURE 2